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Advances in Space Research 34 (2004) 820–827
ADVANCES IN SPACE RESEARCH (a COSPAR publication)
www.elsevier.com/locate/asr

Global aerosol remote sensing from MODIS

C. Ichoku [a,b,*], Y.J. Kaufman [b], L.A. Remer [b], R. Levy [a,b]

[a] Science Systems and Applications, Inc., 10210 Greenbelt Road, Lanham, MD 20706, USA
[b] Laboratory for Atmospheres, NASA/GSFC code 913, Greenbelt, MD 20771, USA

Received 1 December 2002; received in revised form 12 February 2003; accepted 30 July 2003

Abstract

Global aerosol concentration and size parameters derived from MODIS sensors onboard the Terra and Aqua satellites are continuously being evaluated with ground-based measurements and used for various aerosol studies. These parameters have enabled a two-year assessment of aerosol loading and seasonal trends over several important regions on land and ocean, based on $5 \times 5^{\circ}$ monthly averages. Similar studies were conducted at higher spatial (50×50-km) and temporal (daily) resolutions over selected sites representative of pollution, smoke, dust, and sea-salt aerosol types. Also, a two parameter clustering technique has been employed successfully for categorizing the predominant aerosol types and events affecting selected locations over the Atlantic and Pacific Oceans. In addition, results of regional aerosol radiative forcing calculations over a few regions are reported.

Keywords: Aerosol remote sensing; MODIS; Aerosol concentration and size parameters; Regional aerosol radiative forcing

1. Introduction

The study of atmospheric aerosols is a very important element to understanding the earth's solar radiation budget, water cycle balance, and climate change dynamics. Aerosol particles in the atmosphere scatter and/or absorb earth-bound solar radiation as well as emitted and reflected radiation from the earth, to different degrees, depending on their chemical and physical properties. Also, certain aerosol types interact with cloud droplets, modifying their microphysical properties, thereby influencing their radiative properties and precipitation processes.

As a crucial step toward the understanding of the complex effects of aerosols in the atmosphere, aerosol properties and distribution should first be quantified accurately. Aerosol parameters can be measured in situ or by remote sensing from the ground, aircraft, or satellite. All these methods are important and complementary. However, this study employs satellite remote sensing, which offers the advantage of providing the most extensive coverage in the shortest time interval, thereby allowing for better tracking of regional and global distribution of aerosols, which are extremely dynamic in nature. Since the last several years, many attempts have been made to retrieve certain aerosol properties from satellite data, with some limitations (see Kaufman et al., 1997a for detailed review). Recently, Kaufman et al. (2002) published a treatise on the important role of satellite sensors in providing the much needed aerosol information for global climate studies.

The physical characteristics, composition, abundance, spatial and temporal distribution, as well as the dynamics of global aerosols are still not well known, and new data from satellite sensors can be used to improve current understanding and to give a boost to the effort in future climate predictions. The derivation of aerosol parameters from the MODerate resolution Imaging Spectro-radiometer (MODIS) sensors onboard the Earth Observing System (EOS) Terra and Aqua polar-orbiting satellites ushers in a new era in aerosol remote sensing from space. Terra and Aqua were launched on December 18, 1999 and May 4, 2002, respectively, with

* Corresponding author. Tel.: +1-301-614-6212; fax: +1-301-614-6307.
E-mail address: ichoku@climate.gsfc.nasa.gov (C. Ichoku).

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doi:10.1016/j.asr.2003.07.071